MODULAR CONSTRUCTION SYSTEM

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation of the co-pending continuation-in-part application entitled System for Modular Construction, which was filed on July 11, 2002, assigned Serial No. 10/192,940 and issued as U.S. Patent No. _____. The continuation-in-part application was filed as a copending application of the application entitled System for Modular Construction, which was filed on May 7, 1999, assigned a serial number of 09/307,229, and subsequently abandoned. The disclosures of the co-pending continuation-in-part application and the abandoned application are fully incorporated herein by reference.

FIELD OF INVENTION

This invention relates generally to an apparatus for producing a scalable, modular construction from a plurality of structural members having certain standardized features. More particularly, the invention relates to a system for modular construction that is capable of producing assembled units of infinite scalability using interchangeable structural members having detachably connecting slots defined by a standardized spacing model. The apparatus of the invention permits the construction of an endless variety of structurally stable arrangements using a plurality of interchangeable and replaceable structural members without the use of tools or fastening devices.

EXPLANATION OF TECHNICAL TERMS

As used herein, the phrase **connected slot-to-slot** describes a detachable connection made between complementary slots on two structural members. According to the invention, structural

members are **connected slot-to-slot** by press-fitting a slot on one structural member into a slot on another structural member while the structural members are generally perpendicular to each other. When structural members are **connected slot-to-slot**, the result is a snug but detachable engagement between the structural members.

As used herein, a **connecting member** is a structural member having at least two slots that is detachably connected slot-to-slot to a structural member of one subassembly and to a structural member of another subassembly. According to the invention, a **connecting member** may be detachably connected slot-to-slot to more than one structural member of one subassembly and/or more than one structural member of another subassembly. In addition, a **connecting member** may be detachably connected slot-to-slot to more than two different subassemblies.

As used herein, the term **predetermined slot-to-side distance** is the distance measured from a side of a structural member to a slot axis of the slot nearest said side. More particularly, for a preferred structural member having one or more slots on a lengthwise side, the **predetermined slot-to-side distance** is the distance from a widthwise side to the slot axis of the slot on a lengthwise side that is located nearest the widthwise side. For a preferred structural member having one or more slots on a widthwise side, the **predetermined slot-to-side distance** is the distance from a lengthwise side to the slot axis of the slot on a widthwise side that is located nearest the lengthwise side. It is understood that the **predetermined slot-to-side distance** may be a feature of structural members that are rectangular (including those that are square), as well as structural members of other shapes. For non-rectangular members, the **predetermined slot-**

to-side distance is the distance from the slot axis of the slot nearest the nearest end of the side on which it is located to said end of said side.

As used herein, the term **slot** is a long, narrow opening in a structural member which adapted to be detachably connected to a **slot** in another structural member. Each **slot** of the system of the invention is defined by an open end, a closed end opposite said open end, and a pair of equal-lengthed, parallel slot sides extending between the open end and the closed end. The open end of each **slot** of the system is located along a member side of a structural member. Each **slot** of the system also includes a slot axis as defined below.

As used herein, the term **slot axis** is an imaginary straight line extending between the open end and closed end of a slot. The **slot axis** of each slot in the system is parallel to and equally-spaced between the slot sides.

As used herein, the term **whole-number multiple of the predetermined slot-to-side distance** is any whole number multiple of the predetermined slot-to-side distance as that term is defined above. The term **whole-number multiple of the predetermined slot-to-side distance** includes the whole number multiple 1.

BACKGROUND AND DESCRIPTION OF THE PRIOR ART

It is known to connect a plurality of structural members using complementary slots to form assembled constructions. For example, U.S. Patent No. 2,854,724 of Wuorio discloses a molding apparatus comprising a plurality of structural members. According to the Wuorio

patent, each structural member has two parallel sides extending lengthwise and two parallel sides extending widthwise whereby an equal thickness is defined between two planar sides. In addition, the structural members have slots, and each slot has a pair of sides, an end, and a center line. The slots of the structural members engage each other in order to assemble the molding apparatus of the invention.

Another example of such an apparatus is disclosed by U.S. Patent No. 3,069,216 of Vaeth. The Vaeth patent discloses a desk that is assembled by connecting complementary slots on a plurality of structural members. The structural members of the apparatus have slots of varying depth on one or more sides of the structural members. Like the Wuorio apparatus, each of the slots in the structural members of the Vaeth desk are defined by an open end, a closed end, and a pair of sides.

The previously-described devices, however, each suffer from one or more disadvantages. None of the previously-described devices can be enlarged by adding additional structural members. For example, the molding apparatus of the Wuorio patent cannot be expanded upon to produce a molding apparatus comprising more structural members than are illustrated in Figure 9. Instead, the Wuorio patent discloses a molding apparatus that is locked into an assembled construction using locking element 16 such that the assembled structure cannot be expanded. Thus, the molding apparatus of the Wuorio patent cannot exceed the length of its longest structural member or the width of its widest structural member. Simply put, the molding apparatus of the Wuorio patent cannot be "grown" outside the box created by the four largest molding elements. Similarly, the desk of the Vaeth patent cannot be expanded to produce a desk comprising more

structural members than are illustrated in Figure 1 through 3 and 6. The desk of the Vaeth patent cannot be expanded by adding a second desktop or another pedestal of bookshelves. Thus, both the Wuorio patent and the Vaeth patent describe devices limited in size by the dimensions of their largest individual structural members. Consequently, neither Wuorio nor Vaeth disclose devices that are scalable. Scalability is the ability to duplicate, or replicate *ad infinitum*, subassemblies of structural members to produce a larger assembled unit. When scaling is employed, a plurality of subassemblies are detachably connected together with one or more connecting members to produce a larger assembled unit.

It would be desirable, therefore, if a system of modular construction were developed that could be used to produce an assembled unit from a plurality of subassemblies of structural members and one or more connecting members. It would also be desirable if such a system were developed that could be used to connect a plurality of subassemblies in a non-planar or "brick and mortar" style construction. It would be further desirable if such a system were developed that allowed for the replacement of like structural members with unlike structural members to make repair and replacement easier and less expensive. It would be still further desirable is such a system were developed that allowed for the construction of structurally stable assemblies of limitless dimensions without the use of tools or fastening devices.

ADVANTAGES OF THE INVENTION

Accordingly, it is an advantage of the invention claimed herein to provide an apparatus for a system of modular construction that may be used to produce an assembled unit from a plurality of subassemblies of structural members and one or more connecting members. It is another

advantage of the invention to provide a system that can be used to connect a plurality of subassemblies in a non-planar or "brick and mortar" style construction. It is yet another advantage of the invention to provide a system that allows for the replacement of like structural members with unlike structural members so that repair and replacement of the structural members is easier and less expensive. It is also and advantage of the invention to provide a system that allows for the construction of structurally stable assemblies of limitless dimensions without the use of tools or fastening devices.

Additional advantages of this invention will become apparent from an examination of the drawings and the ensuing description.

SUMMARY OF THE INVENTION

The invention comprises an assembled unit which includes a first subassembly, a second subassembly, and a connecting member. The first subassembly comprises a plurality of first structural members, each of which includes a plurality of first member sides. At least one of the first member sides includes a first member slot having a first member slot axis. Further, at least one of the first structural members of the first subassembly has at least two first member slots. Each of the first structural members of the first subassembly is detachably connected slot-to-slot to at least one other first structural member to produce the first subassembly. The second subassembly comprises a plurality of second structural members, each of which includes a plurality of second member sides. At least one of the second member sides includes a second member slot having a second member slot axis. Further, at least one of the second structural members of the second subassembly has at least two second member slots. Each of the second structural members of the second subassembly is detachably connected slot-to-slot to at least one

other second structural member to produce the second subassembly. Finally, a connecting member having at least two slots is detachably connected slot-to-slot to at least one of the first structural members and to at least one of the second structural members to produce the assembled unit.

In the preferred embodiment of the invention, the structural members are rectangular in shape, having a pair of equal-lengthed, parallel lengthwise sides, a pair of equal-lengthed, parallel widthwise sides, and a thickness. Also in the preferred embodiment of the invention, the slots on the structural members are located according to a standardized spacing model. More particularly, for a structural member having one or more slots on a lengthwise side, the distance between a widthwise side and the slot axis of the slot that is located nearest the widthwise side is a predetermined slot-to-side distance. For a structural member having one or more slots on a widthwise side, the distance between a lengthwise side and the slot axis of the slot that is located nearest the lengthwise side is a predetermined slot-to-side distance. In addition, for a structural member having two or more slots on any one side, the distance between the slot axes of the slots is a whole-number multiple of the predetermined slot-to-side distance.

In order to facilitate an understanding of the invention, the preferred embodiments of the invention are illustrated in the drawings, and a detailed description thereof follows. It is not intended, however, that the invention be limited to the particular embodiments described or to use in connection with the apparatus illustrated herein. Various modifications and alternative embodiments such as would ordinarily occur to one skilled in the art to which the invention

relates are also contemplated and included within the scope of the invention described and claimed herein.

BRIEF DESCRIPTION OF THE DRAWINGS

The presently preferred embodiments of the invention are illustrated in the accompanying drawings, in which like reference numerals represent like parts throughout, and in which:

Figure 1a depicts a representative structural member having slots in a lengthwise side in accordance with the present invention.

Figure 1b depicts a perspective view of the representative structural member depicted in Figure 1a.

Figure 2 depicts a representative structural member having a slot in each widthwise side in accordance with the present invention.

Figure 3 depicts a representative structural member having a pair of slots in each widthwise side in accordance with the present invention.

Figures 4a through 4f depict a selection of representative structural members having one or more slots in a lengthwise side in accordance with the present invention.

Figure 5 depicts an exemplary subassembly of two structural members, each having slots in a lengthwise side in accordance with the present invention.

Figure 6 depicts an exemplary subassembly of one structural member having slots in a lengthwise side and one structural member having a slot in each widthwise side in accordance with the present invention.

Figure 7 depicts an exemplary subassembly of structural members, each having one or more slots in a lengthwise side in accordance with the present invention.

Figure 8 depicts an exemplary subassembly of structural members, each having slots in a lengthwise side in accordance with the present invention.

Figure 9 depicts an exemplary assembled unit comprising two subassemblies of structural members, each having slots in a lengthwise side, and one connecting member having slots in a lengthwise side.

Figure 9a depicts an exemplary assembled unit comprising two subassemblies of structural members, each having slots in a lengthwise side, and one connecting member having slots in a lengthwise side.

Figure 9b depicts an exemplary assembled unit comprising two subassemblies of structural members, each having slots in a lengthwise side, and one connecting member having slots in each widthwise side.

Figure 10 depicts an exemplary assembled unit comprising two subassemblies of structural members, each having slots in a lengthwise side, and two connecting members, each having slots in a lengthwise side.

Figure 11 depicts an exemplary assembled unit comprising three subassemblies of structural members, each having slots in a lengthwise side, and two connecting members, each having slots in a lengthwise side.

Figure 11a depicts an exemplary assembled unit comprising three subassemblies of structural members, each having slots in a lengthwise side, and one connecting member having slots in a lengthwise side.

Figure 12 depicts an exemplary assembled unit comprising two subassemblies of structural members, each having slots in a lengthwise side, one subassembly of structural members having slots in each widthwise side, and two connecting members, each having slots in each widthwise side.

Figure 13 depicts an exemplary assembled unit comprising a plurality of subassemblies of structural members, each having slots in a lengthwise side, and a plurality of connecting members, each having at least two slots in a lengthwise side.

DESCRIPTION OF THE PREFERRED EMBODIMENTS OF THE INVENTION

Referring now to the drawings, Figures 1a through 13 illustrate various embodiments of the apparatus of the invention. The basic unit of construction for the system of the invention is a

structural member adapted to be detachably connected slot-to-slot to one or more other structural members. Structural member 10 comprises two equal-lengthed, parallel lengthwise sides 12, 14 and two equal-lengthed, parallel widthwise sides 16, 18. Structural member 10 is merely representative of the possible configurations of structural members according to the invention. While the preferred structural member of the system is rectangular in shape, a structural member may be any suitable conventional shape having at least three sides such as a triangle, a square, a trapezoid, another polygon or the like. It is also contemplated that one or more sides of a structural member may be arcuate, curved, bowed, bending, wavy, or angled.

As shown in Figure 1a, exemplary structural member 10 also includes a pair of first member slots 21 and 31 along lengthwise side 12. More particularly, slot 21 is defined by open end 22, closed end 23 opposite open end 22, and a pair of parallel, equal-lengthed slot sides 24 and 25. In addition, slot 21 has slot axis 26 which is parallel to slot sides 24 and 25 and spaced equally between the slot sides. Slot 31 is defined by open end 32, closed end 33 opposite open end 32, and a pair of equal-lengthed, parallel slot sides 34 and 35. In addition, slot 31 has slot axis 36 which is parallel to slot sides 34 and 35 and spaced equally between the slot sides.

Consistent with structural member 10 illustrated in Figure 1a, each slot of the system is defined by an open end, a closed end, and a pair of slot sides extending between the open end and the closed end. The open end of each slot is located along a side of the structural member by which it is defined. The closed end of each slot is opposite the open end. The open end is connected to the closed end by a pair of equal-lengthed, parallel slot sides that extend from the open end to the closed end. Each slot axis is parallel to the slot sides.

Each slot of the system is also defined by a slot depth. The slot depth is defined as the distance from the closed end of the slot to the open end of the slot along a line parallel to the slot sides. The slot depth of each slot on a structural member may be uniform or it may vary. In addition, the slot depth of slots on different structural members may be the same or different. In the preferred embodiment of the invention, the slot depth of each slot in an assembled unit is equal.

Each slot is also defined by a slot width. The slot width is defined as the distance from one slot side to the other slot side along a line perpendicular to the slot sides. In the preferred embodiment of the system, the slot width of all slots is substantially equal to the thickness of each structural member so that every structural member is adapted to be snugly connected slot-to-slot to every other structural member. It is also contemplated that a structural member may include slots having different slot widths and that different structural members may include slots having different slot widths. It is recognized, however, that in order for two structural members of the system to be detachably connected according to the invention, each structural member must include at least one slot having a slot width substantially equal to the thickness of the structural member to which it is connected.

Still referring to Figure 1a, because each of the slots defined by structural member 10 is located along lengthwise side 12, slot axis 26 and slot axis 36 are generally parallel to widthwise sides 16, 18. It is understood that in the preferred structural member, i.e. a rectangular member, a slot along a lengthwise side has slot sides and a slot axis that are parallel to the widthwise sides of the structural member. On the other hand, a preferred structural member including a slot along a

widthwise side has slot sides and a slot axis that are parallel to the lengthwise sides of the structural member.

Referring now to Figure 1b, lengthwise sides 12, 14 and widthwise sides 16, 18 define first planar side 40 and a second planar side (not shown), the planar sides being in parallel planar disposition with respect to each other. The two planar sides of the structural member define thickness 50. It is understood that each structural member of the system defines a pair of parallel, coextensive planar surfaces which define a thickness. While the thickness of each preferred structural member is defined by a pair of parallel, coextensive rectangular planar surfaces, it is contemplated within the scope of the invention that the planar surfaces may be any suitable shape as described above. In addition, the thickness of each structural member in the preferred system is substantially equal to that of each other member in the system so that each structural member of the system may be detachably connected slot-to-slot to every other structural member of the system. It is contemplated, however, that structural members may be provided in a variety of thicknesses in order to accommodate the specific requirements of various applications.

In addition, the lengthwise sides and/or widthwise sides of the structural member may be longer or shorter than those of exemplary structural member 10, as limited only by practicality. In such configurations, it is understood that a structural member may define additional slots along any or all of its sides. However, as later described, the system specifically provides that any structural member may be removed and replaced with one or more unlike structural members as an alternative to altering the configuration of an individual structural member.

Further, while structural member 10 has two slots on one lengthwise side, it is contemplated within the scope of the invention that one or more slots may be located on any side or sides of a structural member. More particularly, in the preferred structural members, i.e. rectangular structural members, one or more slots may be located on either or both lengthwise sides. In addition, one or more slots may be located on either or both widthwise sides. Still further, one or more slots may be located on either or both lengthwise sides and either or both widthwise sides. It is understood that any side of a structural member having more than one slot is a multiple-slot side. It is further understood that a structural member may have more than one multiple-slot side in accordance with the invention.

Referring now to Figure 2, exemplary structural member 100 has one slot on each widthwise side. More particularly, structural member 100 comprises two equal-lengthed, parallel lengthwise sides 112, 114 and two equal-lengthed, parallel widthwise sides 116, 118. The respective lengthwise sides 112, 114 and widthwise sides 116, 118 define first planar side 119 and a second planar side (not shown), the respective planar sides being in parallel planar disposition with respect to each other. The first and second planar sides define a thickness (not shown). As depicted in representative structural member 100, slot 121 is located on widthwise side 118. Slot 121 is defined by open end 122, closed end 123, first side 124, and second side 125. Slot 121 also has slot axis 126 which is parallel to slot sides 124 and 125 and equally spaced between them. Slot 131 is located on widthwise side 116 of structural member 100. Slot 131 is defined by open end 132, closed end 133, first side 134, and second side 135. Slot 131 also has slot axis 136 which is parallel to slot sides 134 and 135 and equally spaced between

them. As shown by Figure 2, slot axes 126 and 136 are also parallel to lengthwise sides 112, 114.

Figure 3 illustrates a structural member having two slots in each widthwise side. More particularly, structural member 200 comprises two equal-lengthed, parallel lengthwise sides 210, 220, and two equal-lengthed, parallel widthwise sides 230, 240. As shown by Figure 3, structural member 200 includes slot 232, slot 234, slot 242, and slot 244. While Figure 3 illustrates a preferred structural member having two slots on each widthwise side, it is contemplated within the scope of the invention that any side of a structural member may include more or less than two slots. Similarly, it is understood that the structural members depicted in Figures 1a, 1b, 2, and 3 are merely representative of the possible configurations of various structural members and the possible sides on which slots may be located.

According to the preferred system of the invention, each slot on a structural member is located along a side of the structural member according to a standardized spacing model. It is this standardized spacing model that provides the preferred system with such advantages as scalability, "brick and mortar" style construction, and interchangeability of parts.
The standardized spacing model of the preferred system is a function of two different distances.

The first relevant distance is the predetermined slot-to-side distance. For an exemplary structural member having one or more slots in a lengthwise side, the predetermined slot-to-side distance is the distance between a widthwise side of the structural member and the slot axis of the slot in the lengthwise side that is located nearest said widthwise side. Referring again to Figure 1a,

structural member 10 includes lengthwise sides 12, 14 and widthwise sides 16, 18. Two slots 21, 31 are located along lengthwise side 12, and each slot is parallel to widthwise sides 16, 18. Each slot is also an equal distance from the widthwise side of the structural member located nearest to such slot. More particularly, the slot axis of each slot is a predetermined slot-to-side distance X from the nearest widthwise side of the structural member. This predetermined slot-to-side distance X is the first relevant distance for the standardized spacing model.

Referring now to Figure 2, the predetermined slot-to-side distance for an exemplary structural member having a slot on a widthwise side is illustrated. For such a structural member, the predetermined slot-to-side distance is the distance between a lengthwise side and the slot axis of the slot in the widthwise side that is located nearest said lengthwise side. As shown in Figure 2, slot axis 126 of first slot 121 is a predetermined slot-to-side distance X from lengthwise side 114 along widthwise side 118. Referring to Figure 3, the slot axis of slot 232 is a predetermined slot-to-side distance X from lengthwise side 210. Again, exemplary structural members 10, 100 and 200 are merely representative of the standardized spacing model as applied to the preferred rectangular-shaped structural members of the system. It is understood that the predetermined distance X may vary depending upon the application of the system. In other words, the predetermined distance X may be any convenient distance such as 6 inches, 9 inches, 12 inches, 18 inches, etc. In the preferred system, however, the predetermined distance X for all structural members of an assembled unit is equal. It is also understood that the predetermined slot-to-side distance for a structural member that is not rectangular in shape is the distance between the slot axis of the slot located nearest to the nearest end of a side and said end of said side.

According to the standardized spacing model, the second critical distance is the distance between the slot axes of a structural member having at least two slots on one side, i.e. on a multiple-slot side. More particularly, the distance between each slot axis on a structural member having at least two slots on one side is a whole number multiple of the predetermined slot-to-side distance X. It is contemplated that a whole number multiple includes 1, i.e., the distance between two slot axes of two slots on one side of a structural member may be equal to the predetermined slot-to-side distance X.

Referring to Figure 3, exemplary structural member 200 has two slots on each widthwise side. The distance between the slot axes of slots 232 and 234 is 2X, or two times the predetermined slot-to-side distance X. Referring to Figure 4b, structural member 420 has two slots on a lengthwise side. The distance between the slot axes of the two slots is 2X or two times the predetermined distance X. It is understood that the standardized spacing model applies to structural members having slots on one or more lengthwise sides and/or one or more widthwise sides, as well as to structural members having one or more slots on any or all of its sides.

Referring to Figures 4a through 4f, representative structural members having slots in a lengthwise side in accordance with the invention are depicted. As previously described with reference to Figures 1a and 1b, the predetermined slot-to-side distance X is the distance between a widthwise side and the slot axis of the slot nearest the widthwise side. As shown in Figures 4a through 4f, structural members 410, 420, 430, 440, 450 and 460 each have slots spaced apart from each other a whole-number multiple of the predetermined slot-to-side distance X. It should also be noted that the slot axis of any slot located on a lengthwise side of a preferred structural

member is spaced apart from each widthwise side a whole-number multiple of the predetermined slot-to-side distance X. For example, referring to Figure 4b, each slot of structural member 420 is spaced apart from each widthwise side a distance of either the predetermined slot-to-side distance X or 3 times the predetermined slot-to-side distance X.

Referring again to the representative examples depicted in Figures 4a through 4f, structural member 410 defines one slot at a predetermined slot-to-side distance X from widthwise side 401 and from widthwise side 402. Structural member 420 defines slots at distances X and 3X from widthwise side 411 and from widthwise side 412. Structural member 430 defines slots at distances X, 2X and 3X from widthwise side 421 and from widthwise side 422. Structural member 440 defines slots at distances X, 3X and 5X from widthwise side 431 and from widthwise side 432. Structural member 450 defines slots at distances X and 5X from widthwise side 441 and from widthwise side 442. Structural member 460 defines slots at distances X, 2X and 5X from widthwise side 451, and X, 4X, and 5X from widthwise side 452. Again, the structural members depicted are merely examples of the various embodiments contemplated within the scope of the invention.

The overall length of structural members is also a whole number multiple of the predetermined slot-to-side distance X. For example, referring to Figure 3, slot 234 is positioned a predetermined slot-to-side distance 3X from lengthwise side 210. In addition, slot 232 is located at three times the predetermined slot-to-side distance X from lengthwise side 220, and slot 234 is located at the predetermined slot-to-side distance X from lengthwise side 220.

Therefore, the overall length of widthwise side 230 is 4X. Referring to Figures 4d through 4f, the overall length of structural members 440, 450, and 460 is 6X.

It should be understood that these illustrated structural members are merely representations of a few of the many slotting combinations possible in keeping with the spirit and scope of the present invention. Again, these illustrated structural members are merely examples of embodiments of the present invention intended the show the spacing relationship of slots within various structural members. Similarly, while the structural members depicted in Figures 4a through 4f depict defined slots on a single lengthwise side, it is understood and appreciated that slots may be defined on both lengthwise sides and/or on one or both widthwise sides, provided the standardizing spacing model described herein is applied. As with all structural members utilized in the present invention, the lengthwise sides and widthwise sides may vary without restriction, so long as the spacing relationship between slots and their respective lengthwise or widthwise sides, as defined herein, remains in accord with the standardized spacing model. In addition, it is also contemplated that structural members may have any number of slots equal to or greater than one on any one or more sides.

Referring now to Figure 5, a simple subassembly of structural members is illustrated. More particularly, subassembly 500 depicts two structural members 10, 10', connected slot-to-slot using slots located along a lengthwise side of each of structural members 10, 10'. Importantly, for structural members such as 10 and 10' to be successfully connected slot-to-slot in a sufficiently rigidly subassembly 500, tolerances for slots as well as thicknesses of the structural members, must be carefully specified and closely monitored during production processes.

Figure 6 depicts a representative subassembly 600 comprising structural member 10 having slots in a lengthwise side and structural member 100 having a slot in each widthwise side. The two respective structural members 10, 100 are connected slot-to-slot. Again, this is merely a representative example of different structural members connected slot-to-slot to produce a subassembly of structural members in accordance with the present invention.

As illustrated by Figure 5 and 6, the structural members of the system may be detachably connected in a variety of ways. According to the preferred system, a slot on a lengthwise side of a structural member may be detachably connected to a slot on a lengthwise side or to a slot on a widthwise side of another structural member. Similarly, according to the preferred system, a slot on a widthwise side of a structural member may be detachably connected to a slot on a lengthwise side or to a slot on a widthwise side of another structural member. Structural members having more than one slot on a side may be detachably connected with a slot from each of a plurality of other structural members.

More elaborate examples of subassemblies constructed in accordance with the present invention are depicted in Figures 7 and 8. Referring now to Figure 7, subassembly 700 is comprised of a plurality of structural members connected slot-to-slot. More specifically, two structural members 710, each having a slot in a lengthwise side, two structural members 730, each having two slots in a lengthwise side, and two structural members 750, each having three slots in a lengthwise side are connected slot-to-slot to provide a versatile subassembly with a vast array of possible applications.

Figure 8 depicts an example of another subassembly in accordance with the present invention. More particularly, subassembly 800 comprises three structural members 810, each having four slots in a lengthwise side and four structural members 830, each having three slots in a lengthwise side. It is understood that Figures 7 and 8 are merely representative of the variety of subassemblies that may be constructed according to the present invention.

Figure 9 depicts an example of an assembled unit constructed according to the system of the invention. As shown in Figure 9, assembled unit 900 comprises first subassembly 910, second subassembly 920, and connecting member 930. More particularly, first subassembly 910 comprises a plurality of first structural members 911, 912, 913, 914, 915 and 916. Each of the first structural members has a plurality of first member sides. More particularly, each of the first structural members has four first member sides. Each of the first structural members also has at least one first member slot. More particularly, each of the first structural members has two or more slots in a lengthwise side. The plurality of first structural members are detachably connected slot-to-slot to produce the first subassembly.

Second subassembly 920 comprises a plurality of second structural members 921, 922, 923, 924, 925 and 926. Each of the plurality of second structural members has a plurality of second member sides. More particularly, each of the second structural members has four second member sides. Each of the second structural members also has at least one second member slot. More particularly, each of the second structural members has two or more slots in a lengthwise

side. The plurality of second structural members are detachably connected slot-to-slot to produce the second subassembly.

First subassembly 910 and second subassembly 920 are detachably connected slot-to-slot by connecting member 930 to produce assembled unit 900. As shown in Figure 9, connecting member 930 includes two slots 931, 932. Slot 931 of connecting member 930 is detachably connected slot-to-slot to slot 917 in structural member 916, and slot 932 of connecting member 930 is detachably connected slot-to-slot to slot 927 in structural member 926.

As described below, assembled unit 900 is merely one example of the possible ways in which an assembled unit may be constructed according to the system of the invention. The first and second subassemblies may be assembled from more structural members, fewer structural members, or different structural members. The first subassembly may be assembled from different structural members than the second subassembly. As described below, the assembled unit may comprise more than two subassemblies. In addition, the connecting member may be different from the two slot connecting member depicted in Figure 9. For example, structural members 912 and 922 may be removed from subassembly 910 and 920, respectively, and connecting member 930 may be replaced with a preferred structural member having six slots in a lengthwise side.

Referring now to Figure 9a, assembled unit 940 comprises first subassembly 950, second subassembly 960, and connecting member 970. First subassembly 950 comprises structural members 951, 952, 953, 954, and 955. Each of the structural members of subassembly 950 are

detachably connected slot-to-slot. Second subassembly 960 comprises structural members 961, 962, 963, 964, and 965. Each of the structural members of subassembly 960 are detachably connected slot-to-slot. Connecting member 970 includes six slots 971, 972, 973, 974, 975, and 976. Slots 971, 972, and 973 are detachably connected slot-to-slot to slot 956 in structural member 953, slot 957 in structural member 954, and slot 958 in structural member 955, respectively. Slots 974, 975, and 976 are detachably connected slot-to-slot to slot 966 in structural member 963, slot 967 in structural member 964, and slot 968 in structural member 965, respectively.

It is also contemplated within the scope of the invention that a connecting member having more or less than six slots may be used to connect the two subassemblies depicted by Figure 9a. Furthermore, more than one connecting member may be used to connect the two subassemblies shown in Figures 9 and 9a. For example, referring to Figure 9, structural members 911 and 921 may be removed from subassemblies 910 and 920, respectively, and replaced by a second connecting member having six slots on a lengthwise side. Similarly, referring to Figure 9a, structural members 951 and 961 may be removed from subassemblies 950 and 960, respectively, and replaced by a second connecting member having six slots on a lengthwise side.

Figure 9b illustrates yet another assembled unit comprising a pair of subassemblies and one connecting member. As illustrated by Figure 9b, assembled unit 980 comprises first subassembly 981, second subassembly 990, and connecting member 999. More particularly, first subassembly 981 includes structural members 982, 983, 984, and 985. Each of the structural members of the first subassembly are detachably connected slot-to-slot. In addition, each of the

structural members of the first subassembly have first member slots in a lengthwise side. Second subassembly 990 includes structural members 991, 992, 993, and 994. Each of the structural members of the second subassembly are detachably connected slot-to-slot. In addition, each of the structural members of the second subassembly have second member slots in a lengthwise side. Connecting member 999 detachably connects first subassembly 981 to second subassembly 990. Furthermore, connecting member 999 has slots in each of its widthwise sides. Thus, according to the system of the invention, one or more connecting members having slots in only the widthwise sides may be used to detachably connect one or more subassemblies having structural members with slots in a lengthwise side. Still further, one or more connecting members having slots in only the lengthwise sides may be used to detachably connect one or more subassemblies having structural members with slots in one or more widthwise sides.

Referring now to Figure 10, assembled unit 1000 comprises first subassembly 1010, second subassembly 1030, first connecting member 1050, and second connecting member 1060. First subassembly 1010 comprises structural members 1011, 1012, 1013, 1014, 1015, and 1016. Each of the structural members of the first subassembly are detachably connected slot-to-slot. Second subassembly 1030 comprises structural members 1031, 1032, 1033, 1034, 1035, and 1036. Each of the structural members of the second subassembly are detachably connected slot-to-slot. Connecting members 1050 and 1060 detachably connect the first subassembly to the second subassembly. More particularly, first connecting member 1050 includes slots 1051, 1052, 1053, 1054, 1055, and 1056. Slot 1051 is connected to slot 1017 in structural member 1014, slot 1052 is connected to slot 1018 in structural member 1015, and slot 1053 is connected to slot 1019 in structural member 1016. Slot 1054 is connected to slot 1037 in slot 1034, slot 1055 is connected

to slot 1038 in slot in structural member 1035, and slot 1056 is connected to slot 1039 in structural member 1036. Second connecting member includes slots 1061, 1062, 1063, 1064, 1065, and 1066. Slot 1061 is connected to slot 1020 in structural member 1014, slot 1062 is connected to slot 1021 in structural member 1015, and slot 1063 is connected to slot 1022 in structural member 1016. Slot 1064 is connected to slot 1040 in structural member 1034, slot 1065 is connected to slot 1041 in structural member 1035, and slot 1066 is connected to slot 1042 in structural member 1036. It is contemplated within the scope of the invention that more or less than two connecting members may be used to connect first subassembly 1010 and second subassembly 1030. It is further contemplated that connecting members having more or less than six slots may be used to connect first subassembly 1010 and second subassembly 1030. It is also contemplated within the scope of the invention that a plurality of subassemblies may be detachably connected slot-to-slot by a plurality of unlike connecting members. Still further, it is contemplated that one or more connecting members may connect more than two subassemblies.

Figure 11 depicts assembled unit 1100 comprising three subassemblies and two connecting members. First subassembly 1110 includes structural members 1111, 1112, 1113, 1114, 1115 and 1116. Second subassembly 1120 includes structural members 1121, 1122, 1123, 1124, and 1125. Third subassembly 1130 includes structural members 1131, 1132, 1133, 1134, 1135, and 1136. The structural members of each of the three subassemblies are detachably connected slot-to-slot to produce the three individual subassemblies. First subassembly 1110 and second subassembly 1120 are detachably connected slot-to-slot by connecting member 1140. More particularly, slot 1141 on connecting member 1140 is connected to slot 1117 on first subassembly structural member 1116, slot 1142 on connecting member 1140 is connected to slot

1127 on second subassembly structural member 1123, and slot 1143 on connecting member 1140 is connected to slot 1128 on second subassembly structural member 1124. Second subassembly 1120 and third subassembly 1130 are detachably connected slot-to-slot by connecting member 1150. More particularly, slot 1151 on connecting member 1150 is connected to slot 1129 on second subassembly structural member 1125, and slot 1152 on connecting member 1150 is connected to slot 1137 on third subassembly structural member 1134. The assembled unit depicted by Figure 11, like the assembled units of Figures 9, 9a, 9b, and 10, is merely one example of the variety of subassemblies and connecting members that may be used to produce an assembled unit according to the system of the invention. Further, while Figures 9 through 10 show subassemblies being connected in a horizontal orientation, it is contemplated within the scope of the invention that subassemblies like those depicted in Figures 9 through 10 may be connected in a vertical orientation to produce assembled units.

Referring now to Figure 11a, assembled unit 1160 comprises three subassemblies and one connecting member. More particularly, assembled unit 1160 comprises first subassembly 1110, second subassembly 1120, and third subassembly 1130, as described above. In addition, assembled unit 1160 includes connecting member 1170 having five slots 1171, 1172, 1173, 1174, and 1175 in a lengthwise side. Slot 1171 is connected to slot 1117 on first subassembly structural member 1116, slot 1172 is connected to slot 1127 on second subassembly structural member 1123, slot 1173 is connected to slot 1128 on second subassembly structural member 1124, slot 1174 is connected to slot 1129 on second subassembly structural member 1125, and slot 1175 is connected to slot 1137 on third subassembly structural member 1134. It is

contemplated within the scope of the invention that more or less than three subassemblies may be detachably connected slot-to-slot by one connecting member.

Figure 12 depicts another example of an assembled unit constructed according to the system of the invention. Assembled unit 1200 comprises three subassemblies and two connecting members. More particularly, assembled unit 1200 comprises first subassembly 1210 including four structural members 1211, 1212, 1213, and 1214. Each of the four structural members of the first subassembly are connected slot-to-slot by slots on the widthwise sides of the structural members. Second subassembly 1220 and third subassembly 1230 each include four structural members that are connected slot-to-slot by slots on a lengthwise side of the structural members. The second subassembly includes structural members 1221, 1222, 1223, and 1224. The third subassembly includes structural members 1231, 1232, 1233, and 1234.

The assembled unit further comprises connecting members 1240 and 1250, each having a pair of connecting member slots in each of the widthwise sides. As illustrated in Figure 12, the pair of connecting member slots in one widthwise side of connecting member 1240 are detachably connected slot-to-slot with a slot on second subassembly structural member 1223 and a slot on second subassembly structural member 1224. The pair of connecting member slots on the other widthwise side of connecting member 1240 are detachably connected slot-to-slot with a slot on first subassembly structural member 1211 and a slot on first subassembly structural member 1212. The pair of connecting member slots in one widthwise side of connecting member 1250 are detachably connected slot-to-slot with a slot on third subassembly structural member 1233 and a slot on third subassembly structural member 1234. The pair of connecting member slots

on the other widthwise side of connecting member 1250 are detachably connected slot-to-slot with a slot on first subassembly structural member 1211 and a slot on first subassembly structural member 1212.

By maintaining the spacing of the slots on a structural member according to the standardized spacing model described above, several advantages are realized. First, the standardized spacing model of the preferred system provides the system with "scalability." Scalability is the ability to duplicate, or replicate *ad infinitum*, smaller assemblies of structural members (subassemblies) to produce a larger assembled unit. The standardized spacing model allows the assembled unit produced by connecting a plurality of subassemblies to maintain the same spaced relationship between the structural members as existed before the plurality of subassemblies were connected. In other words, the standardized spacing model permits the formation of several different subassemblies to be produced, each such subassembly being produced by a plurality of structural members and having a spaced relationship between the structural members which defines the look or proportionality of the subassembly. Then the standardized spacing model allows the different subassemblies to be connected without altering the spaced relationship between the structural members of the individual subassemblies. Consequently, the "look" or proportionality of a subassembly may be maintained even after the subassembly is incorporated into a larger assembled unit.

The "scalability" of the Applicant's invention overcomes several disadvantages the prior art. For example, the overall dimensions of an assembled unit of the Applicant's invention may exceed the length or width of its largest individual structural member. The "scalability" of the

subassemblies of Applicant's invention allows the user to create customized, aesthetically-pleasing structures of small or large proportions and horizontal or vertical dispositions. Further, the dimensions of the assembled unit of the Applicant's invention may be longer and/or wider than the length or width of the longest or widest individual structural member. Still further, the dimensions of the assembled unit of the Applicant's invention may be longer and/or wider than the length or width of the longest or widest dimension of a subassembly of structural members.

The standardized spacing model of the structural members of the system provides another advantage. The subassemblies of the system may detachably connected such that the locations where the connections are made are staggered or non-planar. More particularly, the system provides that a subassembly of structural members may be detachably connected to other subassemblies such that the abutting sides of coplanar structural members are not aligned along a vertical or horizontal plane. In other words, the subassemblies may be detachably connected to each other in a "brick-and-mortar" style construction. As a result, an assembled unit with greater structural stability than conventional systems is produced. In addition, the "brick and mortar" style construction minimizes or eliminates the need for additional fasteners on the structural members.

By way of illustration, the structural members of the invention may be connected to produce subassemblies that may be connected to produce an assembled unit as shown in Figure 13. As illustrated in Figure 13, the Applicant's system allows for connections between abutting coplanar structural members of different subassemblies (illustrated by solid lines parallel to the widthwise sides of the structural members) to be made in non-planar or staggered locations. In other words,

the Applicant's system does not require the side-by-side or vertical stacking of subassemblies in order to "scale" the subassemblies into an assembled unit. Instead, the apparatus of the Applicant's invention allows for the larger assembled unit, such as unit 1310, to be made up of a plurality of smaller subassemblies that are interconnected at staggered or non-planar locations so as to improve the structural integrity of the larger assembled unit. As a result, the system of the Applicant's invention may be assembled without the use of fastening devices like dowels, threaded fasteners or the like. Of course, it is contemplated within the scope of the invention that suitable conventional fastening devices such as threaded fasteners, brackets, dowels and dowel holes, adhesives, snaps, interlocking grooves or channels, magnets and the like may be used in connection with the present invention in order to reinforce or strengthen the connection between structural members. Moreover, the system of the Applicant's invention provides a greater degree of structural integrity than a conventional side-by-side or vertically-stacked modular system.

Referring to Figure 13, assembled unit 1310 includes a first subassembly, a second subassembly, a third subassembly, and two connecting members. More particularly, the first subassembly comprises structural members 1311, 1312, 1313 1314, 1315, 1316 and 1317. The second subassembly comprises structural members 1318, 1319, 1321, 1322, 1323, and 1324. The first subassembly is detachably connected slot-to-slot to the second subassembly using connecting member 1320. The third subassembly comprises structural members 1325, 1326, 1327, 1328, 1329, 1330, and 1331. The second subassembly is detachably connected slot-to-slot to the third subassembly using connecting member 1332. It is understood that assembled unit 1310 is merely an example of an assembled unit comprising a plurality of subassemblies detachably connected slot-to-slot by one or more connecting members. It is further understood that

assembled unit 1310 illustrates only one of the plurality of ways in which a plurality of subassemblies may be detachably connected slot-to-slot by one or more connecting members such that the abutting ends of coplanar structural members from different subassemblies do not all align along a common plane.

The standardized spacing model of the system provides yet another advantage. The standardized spacing model allows for the replaceability and interchangeability of the structural members within a subassembly or an assembled unit. More particularly, the standardized spacing model permits the replacement of like structural members with unlike structural members without altering the fixed spaced relationship between the structural members of the individual subassemblies or the assembled unit. For example, one structural member may be used to replace two or more different structural members while maintaining the same spaced relationship between the different structural members. Conversely, more than one structural member may be used to replace one different structural member while maintaining the spaced relationship between the different structural members. The replaceability and interchangeability of the structural members of the Applicant's invention provides the user with a convenient, inexpensive way to repair, maintain, and "scale" the structure. In addition, the replaceability and interchangeability of the structural members allows the user to maximize the structural integrity of the system as it is "scaled."

By way of illustration, the structural member illustrated in Figure 4d may be removed from a subassembly or an assembled unit in which it is a component and replaced by the two structural members illustrated in Figures 4a and 4c. Conversely, a subassembly or an assembled unit

including the two structural members illustrated in Figures 4a and 4c (in substantially coplanar and adjacent disposition with respect to each other) may be removed and replaced by the structural member illustrated in Figure 4d. Additionally, the "scaling" process may be facilitated by replacing one shorter structural member such as illustrated by Figure 4b with a longer member such as illustrated by Figure 4d. Moreover, each of these changes to the system of the Applicant's invention may be made while maintaining the spaced relationship between the different structural members and while maintaining the structural integrity of the structure. Of course, the Applicant's invention also permits the removal of the any one of its structural members and the replacement thereof with another like member without altering the fixed spaced relationship between the structural members of an individual subassembly or an assembled unit.

Although this description contains many specifics, these should not be construed as limiting the scope of the invention but as merely providing illustrations of some of the presently preferred embodiments thereof, as well as the best mode contemplated by the inventor of carrying out the invention. The invention, as described herein, is susceptible to various modifications and adaptations, and the same are intended to be comprehended within the meaning and range of equivalents of the appended claims.

What is claimed is: